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ABSTRACT

A review of literature reveals a need to explicitly incorporate critical thinking skills in the college curriculum. Recent research and theories of reading provide some insight into cognitive processes that would provide a basis for study about how to foster critical thinking. Schema theory, in particular, provides a view of cognition that relies on interaction among levels of processing as suggested by Bloom's taxonomy, rather than on a progression from lower to higher levels. Readers may, according to schema theory, encounter at least two major obstacles to understanding the text at higher levels. If readers do not have adequate schema with which to associate new data, their comprehension of the text may be limited. If they do have appropriate schema but the text does not give appropriate clues to suggest the schema, readers will also have difficulty comprehending the text. Instructors may need to assist students in acquiring new schema or may only need to assist students in activating schema. In addition, individual instructors may be able to create other approaches based on schema theory that will foster critical thinking in students. (DF)

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Teaching Critical Thinking on the College Campus:

An Across the Curriculum Approach

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Thinking critically can be defined as "rationally deciding what to do or believe" (Blair, 1983; Ennis, 1981; Hitchcock, 1983 cited in Norris, 1985). The ability to think critically implies "processes of comparing and discriminating, distinguishing, finding coherent relationships, finding similarities and discrepancies between alternatives. It involves analyzing before deciding which alternative to use" (Lockhart, 1963). Critical thinking requires that "people be able to make reliable observations, make sound inferences, and offer reasonable hypotheses. Critical thinking demands an overall critical spirit and skepticism that leads one to apply the rational processes of critical thinking to issues" (Norris, 1985). Finally, according to Bloom,

The most general operational definition of these abilities and skills is that the individual can find appropriate information and techniques in his previous experience to bring to bear on new problems and situations. This requires some analysis or understanding of the new situation; it requires a background of knowledge or methods which can be readily utilized; and it also requires some facility in discerning the appropriate relations between previous experience and the new situation (Bloom, 1956, p. 38).

In Missions of the College Curriculum, the Carnegie Council for the Advancement of Teaching presented a catalog of goals for higher education developed by Howard Bowen for his study on "Investment in Learning: The Individual and Social Value of American Higher Education." In the partial listing of cognitive learning goals presented here, the high number of those related to critical thinking, as defined above, should be noted.

Verbal skills. Ability to comprehend through reading and listening and to speak and write clearly and correctly. Effectiveness in the organization and presentation of ideas in writing and in discussion.

Quantitative skills. Ability to understand elementary concepts of mathematics and to handle simple statistical data and statistical reasoning.

Substantive knowledge. Acquaintance with the cultural heritage of the West and possibly of other traditions. Awareness of the contemporary world of philosophy, natural science, art, literature, social change, and social issues. Command of vocabulary, facts, and principles in one or more selected fields of knowledge.

Rationality. Ability and disposition to think logically on the basis of useful assumptions. Capacity to see facts and events objectively--distinguishing the normative, ideological, and emotive from the positive and factual. Disposition to weigh evidence, evaluate facts and ideas critically, and to think independently. Ability to analyze and synthesize.

Intellectual tolerance. Freedom of the mind. Openness to new ideas. Willingness to question orthodoxy. Appreciation of intellectual and cultural diversity. Intellectual curiosity. Ability to deal with complexity and ambiguity. Historical perspective and cosmopolitan outlook. Understanding of the limitations of knowledge and thought.

Creativeness. Imagination and originality in formulating new hypotheses and ideas and in the producing of new works of art.

Intellectual integrity. Understanding of the idea of "truth" and of its contingent nature. Disposition to seek and speak the truth. Conscientiousness of inquiry and accuracy in reporting results.

Wisdom. Balanced perspective, judgment, and prudence.

Lifelong learning. Love of learning. Sustained intellectual interests.

(Carnegie Foundation, 1977, Appendix B).

In spite of the inclusion of critical thinking as an educational outcome in higher education goal statements, the expectation that students actually will be able to think critically seems not to be as certain. In recent research designed to examine qualitative differences between selective and less selective liberal arts college, questions on course examinations were studied and classified by Bloom's cognitive taxonomy. In the study, three of the dependent variables corresponded directly to major categories of Bloom's taxonomy: percent knowledge questions, percent comprehension questions, and percent application questions. The researchers yielded to questions raised by other studies about the rank and operational independence of

Bloom's higher levels. Thus, analysis, synthesis, and evaluation were collapsed to form the fourth dependent variable: percent critical thinking questions. The study revealed that approximately 55.5 percent of the examination questions at less selective liberal arts schools and 34.4 percent of the examination questions at selective liberal arts schools were designed to question at the knowledge level of Bloom's taxonomy (Braxton and Nordvall, 1985).

The practice of college faculty, particularly those at less selective liberal arts colleges, of not including in their examinations questions designed to teach or evaluate critical thinking skills, may be reflective of levels of teaching and learning in some college classrooms. According to Robert H. Eniss, professor of the philosophy of education at the University of Illinois, "It's much easier to teach facts so that students can just memorize them. Plus, information gained that way is easier to test" (Chronicle, March 5, 1986). Arthur Chickering held a similar view.

How many colleges and universities explicitly help students develop the intellectual skills necessary to deal with information, manage it, and make intelligent judgments with it? Bloom's Taxonomy of Education Objectives in the Cognitive Domain describes the higher level skills of analysis, synthesis and evaluation and indicates how such skills may be tested. In the 'knowledge society' those 'critical thinking' abilities have indeed become critical. But you can probably count on the fingers of one hand the teachers or courses in your institution where systematic efforts are made to foster such abilities. (Chickering, 1977, p.20)

A need to explicitly incorporate critical thinking skills in the college curriculum is further emphasized by the absence of these skills in entering college freshmen. According to the National Commission on Excellence in Education in their report A Nation at Risk, "many 17-year-olds do not possess the higher order intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written material, only one-fifth can write a persuasive essay, only one-third can solve a mathematics problem requiring several steps" (Commission, 1983, p. 9).

As a result, faculty members and administration at a growing number of colleges and universities are becoming involved in projects to determine the best way to teach their students to become critical thinkers. Current trends suggest two opposing thoughts on the best approach. Some experts propose separate and distinct classes on critical

thinking. In California students on the state university campuses and in the community colleges there must complete a course in critical thinking before they graduate (Chronicle, March 5, 1986). Others oppose the idea of separate classes and suggest emphasizing the application of critical thinking principles to the knowledge of principles in all subjects by using a critical thinking-across-the-curriculum approach. Chickering is a proponent of this view.

Special courses in critical thinking are not needed. The research of Dressel and Mayhew at Michigan State University taught us that back in the 1950's. The productive response is to make such intellectual activities part of all courses and independent studies. Then students develop intellectual competence in relation to substance and skills pertinent to their own needs and purposes, and develop the ability to use those intellectual skills as they pursue further learning to tackle problems on the job, in the community or at home. So far, however, at most colleges time spent preparing for classes and examinations primarily goes to memorizing and acquiring information, rather than learning how to manage it (Chickering, 1977, p.20).

If a critical thinking-across-the-curriculum approach is to be used within a college or university, how might such a plan be implemented by faculty members of individual courses? While there seem to be no definitive answers to this question at this time, it may be helpful to draw on modern theories of reading that address levels of cognition.

Schema Theory

Recent research and theories of reading provide some insight into cognitive processes that would provide a basis for study about how to foster critical thinking. In particular, schema theory of reading provides a view of cognition that relies on interaction among levels of processing, as suggested by Bloom's Taxonomy, rather than on a progression from lower to higher levels. This view differs from a traditional analysis of reading processes that depend on a hierarchical organization of reading skills and levels where each level must be attained before the next level can be achieved (Adams, Collins, 1979).

"Schema theory is a theory about knowledge, how knowledge is represented, and how the representation effects the use of knowledge in particular ways" (Rumelhart, 1977, p. 34). According to schema theory, knowledge is stored in units called schemata. There are schemata for all concepts, relationships, processes, and events. Schema also involve networks of all possible relations, according to each person's experiences, that might be constituents of the concepts being examined. When new information first comes in, the person searches for a slot in some schemata where the information would seem to fit. That knowledge will remain in that schemata unless further information shows that it doesn't fit anymore. In this instance, the person will seek out a new schemata following the principle that all data must be accounted for in schema (Bobrow and Norman, cited in Adams and Collins, 1979). When data enters the schema system lower in the network, it serves to activate higher level schemata as it moves up in the hierarchy. Data that enters the system at a higher level of schema serves to activate a search for information to fit into the subschema network (Adams and Collins, 1979).

In addition to the functions of schema in acquiring knowledge, schema also have an output function (Anderson, 1984) in the form of encoding. According to Adams and Collins,

A fundamental assumption of schema-theoretic approaches to language comprehension is that spoken or written text does not in itself carry meaning. Rather, a text only provides directions for the listener or reader as to how he should retrieve or construct the intended meaning from his own, previously acquired knowledge. The words of a text evoke in the reader associated concepts, their past interrelationships, and their potential interrelationships. The organization of the text

helps him to select among these conceptual complexes. The goal of schema theory is to specify the interface between the reader and the text--to specify how the reader's knowledge interacts and shapes the information on the page and to specify how that knowledge must be organized to support the interaction. (1979, p. 405).

Both the input function of schema and the output function of schema imply ongoing processes of interpretation--analysis, synthesis, and evaluation. Furthermore, according to schema theory, the reader or listener is constantly involved in hypothesis formation and testing in relation to former observations, i.e. what he has seen, heard, observed, or otherwise experienced in order to place information in appropriate schema. Ference Marton conducted a series of experiments to determine the association of the orientation of college students' attention while reading text materials to learning outcomes. Marton found that

students who oriented themselves towards understanding the aim of the text and defined the content to their academic subject in terms of aspects of the surrounding world...seemed to experience knowledge as a part of themselves or as a change in their way of conceptualizing certain phenomena....Conversely, students who simply tried to remember the wording of the text and defined the content to their academic subject in terms of the books which constitute the course literature...tended to experience knowledge as something external, something that existed independent of the person....The two attitudes appeared to be connected with two different conceptions of learning: learning as being something you do and learning as something that happened to you. Further, subjects who belong to the first of the above-mentioned groups learned consistently more than the others....A strong correlation was found between the student's orientation during the process of learning and the understanding they reached (Marton cited in Williams, 1985, p. 321).

In studies designed to assess students' levels of understanding during different teaching presentations, a model based on levels of cognitive processing was proposed (Craik's model cited in Williams, 1985). The model was based on theory consistent with schema theory of reading. In the

first level of cognitive processing students merely attend to auditory or visual stimulation without making any critical discriminations or connections. Ability to remember data processed at this level is very limited. In the second level of cognitive processing, the students begin to attach new data to already existing knowledge (schema). This level of processing establishes a new degree of meaning that is critical to recall and ability to relate future data. Ausubel, Novak, and Hanesian corroborated this notion when they said that learning becomes meaningful when "ideas are related to some relevant, existing aspect of the learner's cognitive structure" (cited in Williams, 1985, p. 328). During the third and deepest level of cognitive processing, "attention moves from the source of the message to its content" (Thielens cited in Williams, 1985, p. 332). Students processing at this level are able to analyze data and begin to make hypotheses and inferences independent of the stimuli (Williams, 1985).

Other researchers in information processing and psycholinguistics are drawing the same conclusions as in the study above. Smith in Comprehension and Learning asserted, "The only effective and meaningful way in which anyone can learn is by attempting to relate new experiences to what he knows (or believes) already" (Smith cited in Vacca, 1985, p. 103). Ausubel supported this view by speaking of a "person's wealth of knowledge as an organized hierarchy that has general concepts at the top, less general concepts in the middle and specific facts at the bottom" (Ausubel cited in Vacca, 1985, p. 103).

Instructors can Help

A reader may, according to schema theory, encounter at least two major obstacles to understanding the text at higher levels. If he does not have adequate schema with which to associate new data, comprehension of the text may be limited. If he does have appropriate schema but the text does not give appropriate clues to suggest the schema, he may have difficulty comprehending the text (Anderson, 1984).

In the first instance, where it may be presumed that students do not have adequate schema with which to associate concepts they are going to read about, the instructor may need to assist students in acquiring new schema. Consider the following sample passage presented by Bransford (1984, p. 390) that students may be asked to read. "Arteries are thick, are elastic, and carry blood that is rich in oxygen from the heart; veins are thinner, are less elastic, and carry blood rich in carbon dioxide back to the heart." Even the student who knows the terms "arteries" and "veins" may have difficulty learning the information in this passage

because he cannot remember whether it is veins or arteries that are thin, which one is elastic, and which one goes to the heart. The problem the learner faces is he has no well-developed schema about the terms so that he cannot rely on any previous knowledge to help him understand the concepts. The facts and relationships about the terms in the passage seem arbitrary and the student must rely on rote memory to recall them. In order to make the facts less arbitrary, the students need to be given information that can clarify their significance or relevance. For instance, in the example above, it should be pointed out to students that blood is pumped in spurts from the heart. These spurts will naturally cause changes in pressure so that the arteries need to be elastic to expand and contract to accommodate the pumping. Since veins carry blood back to the heart, they would not need to be elastic because there would be no great pressure changes. (Bransford, 1984). Such additional information will help students acquire new schema and a significant network of subschema about the concepts of arteries and veins. It is argued that people who understand the significance or relevance of new facts develop knowledge structures (schema) that enable them to deal with new situations (Anderson, 1984), a goal of critical thinking. Information given in such a way to enable students to understand the significance or relevance of it is also better retained and recalled because it has been organized meaningfully into schema and not left as isolated facts that can only be memorized. Instructors may help students acquire new schema by carefully selecting textbooks and readings that explain the significance and relevance of new factual information. Otherwise, detailed explanations in the form of discussion, lecture, alternate readings, or other instructional strategies showing the significance and relevance of concepts to be introduced in the reading should be given prior to the reading.

In the instance when the instructor believes that students have adequate schema to help them encode (bring meaning to the page) and, therefore, comprehend the text at a higher level, he may need only to assist students in activating schema. Prior to making the reading assignment, the instructor may lead a discussion about the concepts that will be presented in the text. In this way, he can help students to associate new facts and ideas with already intact schema so that subschema are activated. Some textbooks are written with advanced organizers that help students recognize general concepts that may be tied into schema. Both of these methods help students to activate schema that will enable them to synthesize and analyze new data in terms of prior knowledge. Another experimental approach has been to ask students to generate in writing a list of ideas that they know to be true regarding a

particular concept to be introduced in the reading. Students are then asked to bring these ideas together into a coherent, cohesive writing. This process is used to activate schema. After the students read the assigned passage, they are asked to write about the topic in terms of their prior knowledge and ideas read in the passage. In this last step, the students must analyze and synthesize new data as well as evaluate it in terms of prior knowledge. Finally, to help students activate schema during the reading process, the instructor may furnish questions that clue the students to what schema should be activated. For example, a question that asks students to explain conflict theory at the end of a reading assignment may be answered on the basis of memory without meaningfulness. However, a question that asks students to explain how a conflict theorist might view the role of schools will activate schema about schools that will help students acquire schema and subschema about conflict theory.

Conclusion

The length and depth of the various components of this paper have been purposeful. The first section is designed to assert the idea among educators that critical thinking is an important goal of higher education that has frequently been addressed in goal statements but not as frequently in college and university classrooms. This section poses the problem of how faculty can teach students to think critically within the traditional courses of a college curriculum. The second section of this paper is a presentation of schema theory in the area of reading. This theory is posed as a basis for a model to foster critical thinking skills across the college curriculum. This section is the longest and contains the most examples so that faculty may acquire a theoretical base on which to build future instructional strategies. The last section of the paper lists briefly some specific examples of how instructors may structure reading assignments in a way to help students acquire and activate schema to read and think at higher levels. This list will hopefully inspire instructors to create other approaches based on schema theory that will foster critical thinking in our students.

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